

TABLE OF CONTENTS

| | | |
|-------|---|----|
| D40 | GENERAL FIRE PROTECTION REQUIREMENTS..... | 2 |
| 1.0 | Application of this Chapter | 2 |
| 2.0 | Acronyms and Definitions | 3 |
| 3.0 | Codes and Standards | 4 |
| 4.0 | Construction | 7 |
| 5.0 | Design Documentation..... | 10 |
| 6.0 | Equipment/Piping Identification | 10 |
| 7.0 | Exposure and Natural Phenomenon Hazards Protection..... | 10 |
| 8.0 | Fire Alarms | 11 |
| 9.0 | Fire Prevention Features | 11 |
| 10.0 | Fire Protection System/Structure/Component (SSC) Design and Installation..... | 12 |
| 11.0 | Life Safety Considerations..... | 12 |
| 12.0 | Pre-Emergency Planning Programs (LANL Responsibilities) | 13 |
| 13.0 | Site Fire Protection Water Distribution | 14 |
| 14.0 | Special Fire/Explosion Hazards | 14 |
| D4010 | SPRINKLERS | 14 |
| 1.0 | General | 14 |
| 2.0 | Design Requirements | 14 |
| D4020 | STANDPIPES..... | 16 |
| D4030 | FIRE PROTECTION SPECIALTIES | 16 |
| 1.0 | Portable Fire Extinguishers | 16 |
| D4090 | OTHER FIRE PROTECTION SYSTEMS..... | 16 |
| 1.0 | Special Extinguishing Systems | 16 |

RECORD OF REVISIONS

| Rev | Date | Description | POC | OIC |
|-----|----------|---|----------------------------------|---------------------------------|
| 0 | 06/28/99 | Fire Protection requirements from the Architectural and Mechanical Facilities Engineering Standards, Volumes 4 and 6, incorporated into this chapter. | James Gourdoux, <i>FWO-FP</i> | Dennis McLain, <i>FWO-FE</i> |
| 1 | 11/18/02 | Changed FEM to LEM. Complete revision and addition of endnotes. | Julia Wood, <i>FWO-FP</i> | Kurt Beckman, <i>FWO-SEM</i> |

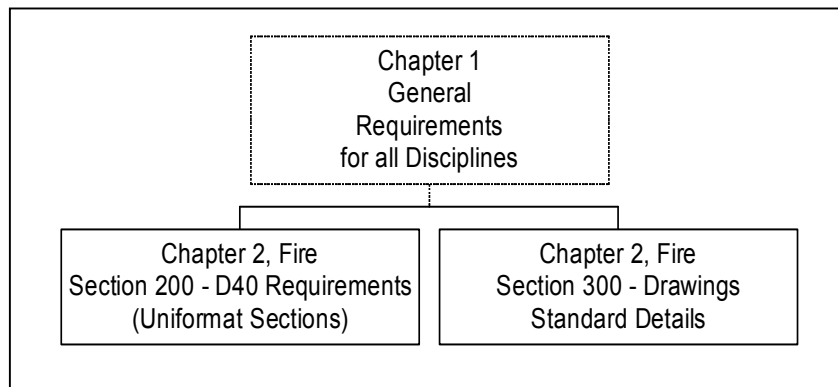
D40 GENERAL FIRE PROTECTION REQUIREMENTS

1.0 APPLICATION OF THIS CHAPTER

1.1 General

- A. This chapter provides fire protection requirements and guidance for sprinkler piping systems and specialties downstream of the base of the riser, including the riser backflow preventer. The requirements and guidance apply to all existing and new LANL facilities, designs for new construction, and for modifications to existing buildings and structures. Refer to the LANL Engineering Manual (LEM) Civil Chapter for requirements upstream of the base of the riser, i.e., fire hydrants, post indicator valves, piping, etc. Fire alarm systems are addressed in the LEM Electrical Chapter (Subsection D5030).
- B. The purpose of this chapter of the LEM is to provide fire protection systems that prevent accidents and mitigate consequences; are free from hazard; are efficient, convenient, and adequate for good service; and are maintainable, standardized, and adequate for future expansion. Code requirements are minimum requirements that are augmented by the site-specific requirements in this chapter.
- C. All fire protection design, material, equipment, and installations shall comply with site-specific requirements in this Chapter and Chapter 1 of the LEM.¹

This hierarchy and the organization of this chapter is depicted below:



- D. When new requirements are issued in the LEM, projects well underway are not required to comply with them. For **small projects**, the point used to determine applicability of new requirements is the FM's or Division Leader's approval to proceed with final design. Final design includes preparation of final working drawings, specifications, bidding documents, cost estimates, and coordination with all parties that might affect the project; development of firm construction and procurement schedules; and assistance in analyzing proposals or bids (from DOE O 4700.1). For **major projects** under the requirements of [LIR 220-01-01, Construction Project Management](#), the point used for determining the application of changes shall be at the beginning of the effort to develop the statement of work for A/E design services. Projects that have achieved this milestone shall be considered "underway" as shall General Plant Project (GPP) activities and Line Item projects that have reached a similar point.⁶
- E. Where appropriate, guidance is provided to aid the cost-effective implementation of site-specific requirements and the requirements in the applicable codes. *Italicized* text identifies recommended guidance (not mandatory), based on good business practice and through lessons-learned at LANL (except when clearly indicating the title of a document). All other text in regular type indicates **mandatory** requirements unless prefaced with wording identifying it as guidance or recommended.
- F. In addition to new installations, this Chapter applies to some renovation, replacement, modification, maintenance, or rehabilitation projects.
1. Bring existing fire protection systems into compliance with current codes and requirements in this chapter when renovation work includes major replacements, modifications, or rehabilitation that exceeds 50% of the estimated replacement value² of the existing fire system or subsystem³, and consider upgrading whenever safety is an issue.
 - a. This requirement applies on a system or subsystem basis.
 - b. Systems and subsystems are listed in Section 210 of Chapter 1 of the LEM.

2.0 ACRONYMS AND DEFINITIONS

| Title | Description |
|-------------------------|--|
| AHJ | Authority having jurisdiction. The LANL Fire Marshal (LANL FP Group Leader) is the AHJ for this LEM Chapter; however, engineering standard-related inquiries should be initially directed to the LEM Fire POC. |
| Design Agency | The organization performing the detailed design and/or analysis of a project or modification. |
| Design Authority | The person or group responsible for the final acceptability of and changes to the design of a system or component and its technical baseline (typically the manager of engineering). |
| FM | Factory Mutual, a nationally recognized testing laboratory. |
| FP | LANL Fire Protection Group |
| IBC | International Building Code |
| LCMS | LANL Construction Specification Manual |

| Title | Description |
|----------------------------|---|
| LEM | LANL Engineering Manual |
| LIG | Laboratory Implementation Guidance |
| LIR | Laboratory Implementation Requirements |
| Major Project | Construction project greater than \$500k (CPM LIR 220-01-01). |
| NFPA | National Fire Protection Association |
| POC | Point of contact. For the LEM chapter/discipline Technical Committee POCs see http://www.lanl.gov/f6stds/pubf6stds/techcommittees.html |
| Small Construction Project | Construction project below \$500k. |
| UL | Underwriters Laboratories |
| WSS | Work Smart Standards. A set of Orders and national codes and standards in Appendix G of the LANL UC Contract. They primarily address Environment, Safety, and Health (ESH). |

3.0 CODES AND STANDARDS

3.1 General

- A. Comply with the applicable portions of the latest edition of each code and standard listed below, referenced elsewhere in this chapter, and others as applicable, unless otherwise specified. LANL Work Smart Standards are denoted as “WSS.”
- B. The adequacy of all design inputs is the responsibility of the designer/design agency. If the designer believes the LEM to be incorrect (e.g., compliance will cause a problem), it is their responsibility to bring the issue to the attention of the LEM Discipline POC (via the Project Manager if appropriate) for resolution.
- C. The engineer/designer is responsible for a complete design package (drawings and specifications) as required to meet project specific requirements. Refer questions concerning the contents in these manuals to the applicable LANL discipline POC. *Guidance: The LANL Engineering Standards are not intended to cover all design requirements and construction specifications necessary to provide a complete operating facility or system. The design organization is responsible to provide a complete design package.*

- D. If there is a conflict between codes, standards, and LANL requirements such as this manual or project programming requirements such as Functional and Operational Requirements (F&OR), contact the LANL Engineering Manual (LEM) Discipline POC for assistance in resolving the conflict. If a requirement in any LANL document exceeds a minimum code or standard requirement, it is not considered a conflict, but a difference, so comply with the most stringent requirements among the LANL documents.⁴
- E. Request for variances and exceptions from the requirements stated in the LANL Engineering Standards shall follow the process outlined in [LIR 301-00-02](#), Variances and Exceptions to Laboratory Operations Requirements. The LANL Fire Marshal (LANL FP Group Leader) is the approving authority for any variations and exceptions to this chapter of the LEM.
- F. Codes of Record: The fire protection-related codes and standards in effect when a facility design commences shall be considered the “codes of record” and shall remain in effect for the life of the facility. Establishment and maintenance of the facility’s design basis, including “codes of record” shall be in accordance with [LIR 240-01-01](#), Facility Configuration Management. As determined by the LANL Fire Marshal, the current edition of the codes or standards applies to the facility modifications.
- G. Online Codes and Standards: Access to selected online national codes and standards including NFPA and UL are available to anyone with a LANL IP address or “smart card” at: <http://lib-www.lanl.gov/infores/stand/standihs.htm>

3.2 LANL Work Smart Standards (WSS) ⁵ http://labs.ucop.edu/internet/app_g/wss_lanl.pdf

- A. Comply with the LANL WSS.
- B. Comply with the latest edition of CFRs listed in the WSS including all other applicable CFRs.
 - 1. CFRs available at: <http://www.access.gpo.gov/nara/cfr/cfr-table-search.html#page1>

3.3 LANL Engineering Standards

- A. Engineering Manual (LEM), OST220-03-01-EM⁶
 - 1. *Guidance: This chapter has been subdivided into sections that allow for more convenient control of information. Section numbering generally follows the UNIFORMAT system promulgated by the Construction Specifications Institute (CSI) and further described in ASTM E1557.*
 - 2. Comply with standard detail drawings in the LEM unless referenced in *italicized* text. Edit the details to reflect the particular details of the project, but obtain LEM Fire Protection POC approval when changing detail requirements.

B. Construction Specifications Manual, OST220-03-01-CSM⁶

1. Comply with the LANL Construction Specifications Manual (LCSM) when writing and preparing a specification package, i.e., format, writing and editing, etc. *Guidance: The LCSM provides construction specifications that are referenced throughout the LEM. Specs are preferred over extensive drawing notes.*
2. Number the specification sections in accordance with the CSI MasterFormat document, but do not renumber LANL Master Specs. *Guidance: LANL Master Specifications that do not conform to CSI numbers are being revised.*
3. Comply with specifications in the LEM unless referenced in *italicized* text. When editing these specifications to suit the project, add job-specific requirements and delete only those portions that in no way apply. To seek a variance from applicable requirements, contact the LEM Fire Protection POC.

C. Drafting Manual, OST220-03-01-DM⁶

1. Comply with the LANL Drafting Manual when creating or revising drawings for facility projects.

D. The above manuals are available at: <http://www.lanl.gov/f6stds/pubf6stds/xternhome.html>

3.4 DOE (Department of Energy) (Selected Orders)

- A. DOE O 420.1, Facility Safety (WSS - with exceptions noted in LANL WSS list).
- B. DOE O 440.1, Explosive Safety Manual (WSS).
- C. DOE STD 1062, Fire Protection Handbook.
- D. DOE STD 1088, Fire Protection for Relocatable Structures.
- E. DOE O 6430.1, General Design Criteria-Division 13, only (WSS).
- F. Above directives available at: <http://www.directives.doe.gov/>

3.5 Building Code

- A. International Building Code (from ICC), latest revision as amended by the LEM (WSS).
 1. Refer to NFPA Codes in this section (except NFPA 5000) for deviations from IBC.
- B. Where the above codes refer to the Administration Authority for Fire Protection matters, refer to the LANL Fire Marshal via the LEM Fire Protection POC.⁶

3.6 Factory Mutual (FM) Insurance Co.

- A. *Guidance: FM Property Loss Prevention Data Sheets.*

- B. Listing of current data sheets is available at: <http://www.fmglobal.com/>

3.7 NFPA (National Fire Protection Association)

- A. National Fire Codes and Standards (WSS)
- B. Buildings and structures designed to fully meet the requirements of NFPA 101, The Life Safety Code, shall be considered to have met the “life safety” requirements of IBC, OSHA (29 CFR 1910), and all other codes.⁷
- C. Listing of current NFPA codes and standards is available at: <http://www.nfpa.org/catalog/> or, for LANL net users, <http://lib-www.lanl.gov/infores/stand/stanihs.htm>

3.8 Society of Fire Protection Engineers

- A. *Guidance: Fire Protection Engineering Handbook.*

4.0 CONSTRUCTION

4.1 General Building Construction Requirements

- A. Fire resistance ratings for buildings shall be based on International Building Code (IBC) or National Fire Protection Association (NFPA) 101 requirements for occupancy type, size, number of floors, adjacent exposures, etc., whichever is more restrictive. Minimum construction for LANL facilities shall be IBC Type II-B or NFPA 220 Type 11(000).⁸

4.2 Construction Materials

- A. NFPA Code 101 (Life Safety Code) and the IBC define restrictions on materials that are used for construction. Specific restrictions that are important to the discipline of fire protection engineering include the following:
1. All materials that are to be used as part of a fire protection system, structure or component (SSC) shall be Listed by Underwriters Laboratories (UL), Approved by Factory Mutual (FM), or Listed by another nationally-recognized testing laboratory for the specified use.
 2. *Guidance: Interior finish materials restrictions (smoke developed and flame spread ratings) provide assurance that occupants of the structure will have a good chance to exit a building during a fire emergency. Flame spread rating restrictions help ensure that a fire will not spread with excessive speed. Smoke developed ratings help to ensure that occupants will be able to locate and reach exits.*
 3. *Guidance: Fire rating requirements for interior and exterior walls define the robustness of the structure when exposed to an interior or exterior fire.*

4.3 Fire Areas

- A. *Guidance: Larger structures, structures with multiple areas with different types of hazards, or structures with multiple types of occupancies (see Section 11.0, Life Safety Considerations) are often segmented into separate Fire Areas. A Fire Area is defined by fire rated barriers. The purpose behind designating a Fire Area is to define the limits of a postulated fire starting within the Fire Area.*

4.4 Fire Barriers

- A. Because fire areas are basic to the fire analysis of a building, the fire barriers that separate fire areas shall be maintained throughout the life of the facility.
- B. Where a wall or floor/ceiling is credited as a fire barrier, its design shall be tested in accordance with ASTM E119 or as described in NFPA 220, Standard on Types of Building Construction.
- C. Additional requirements for fire barriers:
1. If fire areas are utilized to minimize property loss in a structure, barriers shall have a fire rating of not less than 2 hours.⁹
 2. Certain types of occupancies within a structure shall be separated from other types of occupancies in the same structure to provide an increased level of life safety for the occupants of the structure per the IBC and NFPA 101.
 3. Employ fire separation where necessary to separate the bulk of the structure from the passageways/stairways used to exit from the structure during an emergency to provide assurance that occupants will be able to safely exit a building during a fire emergency per NFPA 101.
 4. Provide a fire-rated barrier when identified by a Hazards Analysis as needed to minimize the consequences of a fire within or outside of a facility.

4.5 Fire Barrier Penetrations

- A. When a fire barrier is required for any reason, it shall be maintained in good condition as long as the structure is in operation, or until it is re-evaluated and downgraded by a fire protection engineer (LANL Fire Protection [FP] Group). To maintain good condition of a fire barrier, any openings/penetrations through it shall be appropriately protected.
- B. Fire barrier penetrations of all types shall be appropriately sealed to maintain fire barrier integrity. Seals, or "through-penetration firestop assemblies," shall be Listed by UL, Approved by FM, or Listed by another nationally recognized testing laboratory (reference ANSI/UL 1479, Fire Tests of Through-Penetration Firestops. Where a fire door, fire damper or penetration seal that is not UL/FM approved is to be used in a fire barrier, it shall still be tested to support that it provides adequate fire protection, or it shall be reviewed and accepted by a fire protection engineer (LANL FP Group).

C. Ventilation Penetrations:

1. Ductwork penetrating a fire barrier (of greater than 1 hour fire resistance) shall be equipped with a fire damper in most cases. Fire damper installations shall be in accordance with manufacturers' instructions, maintaining the required gap around the damper to allow for thermal expansion without buckling the damper sides. Also refer to SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.¹⁰
2. Where ductwork penetrates a fire barrier but no fire damper is required, the penetration shall be provided with a seal around the penetration.
3. To prevent travel of smoke, a smoke damper, or a combined fire and smoke damper, shall be used (fire dampers are not credited).
4. Refer to LEM Chapter 6, Section D3040 HVAC Distribution, for additional fire/smoke damper requirements.

D. Doors:

1. Fire doors shall have the appropriate fire rating (reference NFPA 80, Fire Doors and Windows) to maintain the integrity of the barrier in which they are installed.
2. If a door must remain normally open, it shall be equipped with an appropriate mechanism to automatically close the door when there are fire conditions on either side of the barrier. This mechanism shall either be a fusible link allowing the door to close upon high temperatures, or an electromagnetic switch releasing the door upon smoke detection (in the vicinity of the door or area protection) or other initiating device actuation (e.g., manual pull stations, sprinkler system water flow indication, area heat detection). Such mechanisms shall be UL Listed, FM Approved, or listed by another nationally recognized testing laboratory for the intended purpose.

E. Other Types of Penetrations:

1. Piping, cable trays, electrical conduits, and wires penetrating fire barriers shall be sealed using one of a variety of methods. Refer to UL Fire Resistance Directory, Volume II, or the FM Approval Guide, or the listing guide of another nationally recognized testing laboratory, for listings of fire rated penetration seal assemblies.
2. *Guidance: A simple and acceptable fire barrier penetration seal that should be considered for sealing of concrete masonry units or concrete barriers is grout, sealed to the full thickness of the penetrated wall or floor.*
3. Where structural steel penetrates a fire rated barrier, that configuration shall be reviewed by a fire protection engineer (LANL FP Group) to determine if additional fire protection measures are required. The steel can transmit significant heat from one side of the barrier to the other, potentially spreading fire.
4. A window through a fire barrier shall be in accordance with NFPA 80, Fire Doors and Fire Windows. *Guidance: Fire resistant (wired) glass can be used in limited amounts. Shutters or spray systems can be used to protect window openings in the event of a fire. Guidance is available from the LANL FP Group.*
5. Where a conveyor penetrates a fire barrier, it shall be designed to maintain the fire rating of the barrier. *Guidance on how to accomplish this is available from the LANL FP Group.*

5.0 DESIGN DOCUMENTATION

5.1 Calculations

- A. Refer to Subsection D4010, Sprinklers, for calculation requirements.

5.2 Sealing Construction Documents

- A. Comply with the New Mexico Engineering and Surveying Practice Act, Chapter 61, Article 23 NMSA 1978. All fire protection plans, design, drawings, specifications, or reports prepared by consultants or contractors that are involved in the practice of engineering shall bear the seal and signature of a professional engineer in responsible charge and directly responsible for the fire protection engineering work.
 - 1. University employed engineers, performing engineering services involving the operation of LANL, on LANL property, are exempt from the licensing requirements of the New Mexico Engineering and Surveying Practice Act.¹¹
 - 2. *Guidance: Sealing as-built drawings is not required except when Title III construction services with inspection are contracted.*¹²

6.0 EQUIPMENT/PIPING IDENTIFICATION

- A. Refer to NFPA 13 and Mechanical Chapter, Subsection D10-30GEN for requirements.

7.0 EXPOSURE AND NATURAL PHENOMENON HAZARDS PROTECTION

- A. Adjacent Structures: For relocatable structures, DOE-1088-95, DOE Standard on Fire Protection for Relocatable Structures, and NFPA 80A, Recommended Practice for Protection of Buildings from Exterior Fire Exposures, shall be used to determine acceptance criteria for separation of permanent structures that might represent exposure hazards.
- B. NFPA 30, Flammable and Combustible Liquid Code, and other applicable NFPA codes, standards and recommended practices, such as NFPA 70 and NFPA 37 shall be used to determine separation distance between hazardous equipment and structures. *Guidance: Hazardous Equipment (e.g., transformers, diesel generators, etc.): The required separation distance to protect a structure from adjacent hazardous equipment typically depends on the type and size of the associated fire hazard, and on the construction of the building. Also consider the guidance of Factory Mutual Data Sheets, and other similar insurance industry guidelines, to determine appropriate separation distances and fire protection. LANL FP Group is available to provide additional guidance.*

- C. NFPA 299, Standard for Protection of Life and Property from Wildfire, shall be used to determine how to evaluate the degree of wild land fire hazard for a particular facility. DOE M 440.1-1 shall be used to determine special requirements for protection of explosives facilities from wild land fire exposure *Guidance: Wild Land Fire Exposure: Los Alamos County has a dry climate, intense and frequent lightning storms, and steep terrains all of which contribute to increased wild land fire hazard. NFPA 299 also provides different strategies that can be used to reduce wild land fire threat, including establishing fire breaks around facilities (by thinning or eliminating vegetation around the facility), providing fire resistive construction for new structures, ensuring appropriate roadways for emergency vehicle access, etc. Also refer to the Urban Wildland Interface Code (ICBO Item No. UWIS2K) for further guidance.*
1. As a minimum, a 10 foot wide space around buildings shall be maintained clear of all trees. In more heavily forested areas, a 50-foot wide space around buildings shall be maintained clear of trees (several isolated trees may be acceptable), and the next 50 feet beyond shall be thinned. In less heavily forested areas, less clearing/thinning may be acceptable. Consult LANL FP Group for guidance.
- D. Lightning: Los Alamos County experiences intense and frequent lightning storm activity during the summer months, making lightning protection critical for all high-value or otherwise significant LANL facilities. All explosives facilities, all facilities with a replacement value of \$1 million or more (structure and equipment), and facilities of significant programmatic importance shall be equipped with lightning protection in accordance with NFPA 780, Standard for the Installation of Lightning Protection Systems, UL 96A, Installation Requirements for Lightning Protection Systems, Lightning Protection Institute (LPI) Standard No. LPI-175 Standard of Practice. Also reference Construction Specification 16670 on Lightning Protection, and DOE M 440.1-1. For additional requirements refer to the LEM Electrical Chapter.

8.0 FIRE ALARMS

- A. Refer to the Electrical Chapter (especially Section D5030) for fire alarm requirements.

9.0 FIRE PREVENTION FEATURES

- A. Fire prevention features shall be part of the project plans and specifications just as fire protection systems would be.
1. **Combustion Safeguards on Fuel-Fired Equipment.** Follow NFPA 85, NFPA 86, NFPA 86C and NFPA 86D.
 2. **Heating Equipment for Hazardous Areas.** In hazardous (electrically classified) areas, specify heating equipment suitable for these areas. Use indirect fired heating equipment or heat exchangers. Also see NFPA 85.
 3. **Electrical Equipment for Hazardous Areas.** Follow NFPA 70, NFPA 493 NFPA 497 and NFPA 499. Also follow UL/ANSI 913 where applicable.
 4. **Diking/Drainage for Liquids.** Design for safe containment of 110 percent of the capacity of the largest tank. Design shall consider diking, diversionary diking, drainage to catch tanks, or drainage to a safe location. Also see NFPA 30 and NFPA 15 annex.

5. **Fail-Safe Process Design.** Design process equipment to fail safely. For example, heat sources off, feed valves closed, agitation systems running, cooling water valves open, and ventilation on. Fail-safe settings and the interlocks that occur upon failure of process equipment will vary with every process.
6. **Process Monitoring and Interlocks.** Monitor all parameters of a process that could contribute to fire or explosion. Parameters to be considered include but not be limited to pressure, temperature, flow, concentration, agitation, liquid levels and positions of doors and dampers.
7. **Programmatic Combustible Loading.** Design buildings and processes to enable keeping combustible loading at the minimum necessary for normal operations.

10.0 FIRE PROTECTION SYSTEM/STRUCTURE/COMPONENT (SSC) DESIGN AND INSTALLATION

- A. **Design Criteria.** Follow DOE-STD-1066-97, Fire Protection Design Criteria, DOE M 440.1-1 for explosive facilities, and relevant National Fire Protection Association (NFPA) codes, standards, and recommended practices. Also review the Factory Mutual Loss Prevention Data Sheets, and the GE Global Asset Protection Services (formerly Industrial Risk Insurers) Guidelines for Loss Prevention and Control for additional requirements.
- B. **Preparing Calculations.** Calculation methods are presented in relevant NFPA codes, and software to conduct the calculations in accordance with these methods is available. Document and submit calculations for fire protection systems in accordance with FWO-DO Procedure-603, Calculations (follow IFMP 0200-1002, Engineering Calculations, when issued).
- C. **Preparing SSC Drawings.** Comply with the LANL Drafting Manual and the applicable NFPA Code or Standard.
- D. **System Impairment Process.** Follow Criterion 733, Fire Protection System Impairment Control Program, in the LANL Operations and Maintenance Manual (OST 230-05-01). <http://www.lanl.gov/orgs/f/f6/pubf6stds/om/htmls/toc.html>
- E. **Inspection, Testing, and Maintenance (ITM) Criteria.** Follow the inspection, testing, and maintenance criteria outlined in Section 700 of the LANL Operations and Maintenance Manual.

11.0 LIFE SAFETY CONSIDERATIONS

- A. Determine occupancy classification per NFPA 101.¹³
- B. For explosives facilities, comply with additional life safety requirements in DOE M 440.1-1.
- C. Emergency lighting and marking of the means of egress shall be provided as required by NFPA 101. Refer to the LEM Electrical Chapter for additional requirements.

D. *Life safety feature guidance:*

1. *Once the occupancy has been identified, NFPA 101 specifies the life safety features required for the occupancy. These features ensure that occupants of the building will have sufficient early warning and sufficient exits to facilitate safe egress from the building.*
2. *Pay special concern to:*
 - a. *Travel distance from any part of the building to the nearest exit;*
 - b. *Maximum allowed dead end corridor allowed in the building; and*
 - c. *The portion of exit access that is traversed before two separate and distinct paths of travel to two exits are available (common path of travel).*
3. *The limits associated with these features vary by occupancy, and vary for any occupancy type depending on whether or not the building is sprinklered. Where sprinklers are provided, the allowed distances related to exit access generally increase. The presence of sprinklers provides twofold assurance: first, that a fire will be promptly controlled, limiting fire and smoke spread; and second, that the exit pathway will remain protected long enough to get occupants safely out of the building.*

12.0 PRE-EMERGENCY PLANNING PROGRAMS (LANL RESPONSIBILITIES)

- A. Coordinate with LANL FP Group to provide documentation to LAFD describing a new facility or changes to an existing facility so that the Pre-Fire Plans can be kept up to date. *Guidance: The Los Alamos County Fire Department (LAFD) develops and maintains Pre-Fire Plans for important LANL facilities, to aid fire fighters in responding to a facility fire.*
- B. *Guidance: Generic guidance on fire water run-off is somewhat addressed in DOE 6430.1A, "General Design Criteria" for new construction, and DOE O 420.1, paragraph 4.2.2.8. The DOE has also issued a draft document entitled, "Guidance for Estimating Fire Suppression System Run-off Volume in DOE Nuclear and Hazardous Substance Locations." Additionally, the Pre-Fire Plans for each facility address some aspects of firewater run-off. Where there is no specific requirement for fire protection water run-off control at a facility, the facility must monitor fire fighting water run-off and will be required to clean up any resulting contamination. Ensure that Facility Management is aware when a design change might affect fire protection-related water run-off.*
- C. Coordinate with LANL FP Group and/or S-8 Emergency Management and Response (EM&R) to provide up-to-date information on any changes to an existing facility's physical hazards or hazard configuration, so that Pre-Fire Plans can be updated. *Guidance: Fire fighters may encounter a variety of different physical hazards at LANL facilities, including radiological, chemical, cryogen, laser, etc.*
- D. For new or significantly modified facilities, coordinate with the LAFD through EM&R to ensure that LAFD personnel are provided with appropriate tours.

- E. Evacuation plans and Building Run Sheets are required in each facility at LANL. When facility configurations are changed the evacuation plans and Run Sheets shall also be changed. Coordinate with Facility Management for evacuation plans. Coordinate with EM&R for Run Sheets.¹⁴

13.0 SITE FIRE PROTECTION WATER DISTRIBUTION

- A. Refer to the Civil Chapter, Subsection G3010 (future), for site requirements.

14.0 SPECIAL FIRE/EXPLOSION HAZARDS

- A. Special fire and explosion hazards include but are not limited to the following:
 - 1. Warehousing. Follow NFPA 13 and NFPA 230.
 - 2. Gloveboxes and Filter Plenums. Follow DOE-STD-1066-97, Fire Protection Design Criteria, and DOE-HDBK-1081-94, Primer on Spontaneous Heating and Pyrophoricity. Also follow NFPA codes relevant to the hazard including, but not limited to, NFPA 30, NFPA 45, and NFPA 318.
 - 3. Flammable and Combustible Materials. Follow relevant NFPA codes, including, but not limited to NFPA 30 and the NFPA codes on flammable gases, oxidizers, peroxides, and combustible metals.
 - 4. Explosive materials. Follow DOE M 440.1-1, Explosives Safety Manual, and NFPA 495.
 - 5. Paint Spraying/Coating. Follow NFPA 30, NFPA 33 and NFPA 34.
 - 6. Tank Storage of Liquids. Follow NFPA 30 and the appropriate NFPA codes for tank protective systems, including NFPA 15 and NFPA 16.

D4010 SPRINKLERS

1.0 GENERAL

- A. This section provides requirements/guides for sprinkler system piping downstream of the base of the system riser. This section addresses wet pipe, dry pipe, and pre-action sprinkler systems. For deluge and other special-hazard systems, refer to section D4090, Other Fire Protection Systems.

2.0 DESIGN REQUIREMENTS

- A. Provide a complete automatic fire suppression system for a new or modified structure where the maximum possible fire loss exceeds \$1 million (structure and equipment replacement costs)¹⁵ or where determined necessary by the LANL FP Group due to the mission importance of the structure. Such a suppression system need not be an automatic fire sprinkler system.

- B. The minimum design area for an automatic sprinkler system shall be 1500 square feet unless bounded on all sides by either a 2-hour fire rated interior barrier or exterior walls. Hydraulically designed systems shall be designed at least 5 psi below the water supply curve. Final water supply curve shall be after required 500 gpm hose streams and friction loss to the base of the riser have been deducted.
- C. Provide a hydraulically designed automatic sprinkler system for protection of an NFPA 13 ordinary hazard Group 2 occupancy as a minimum, except as approved otherwise by the LANL Fire Marshal.
- D. Provide a separate fire protection service line inside the building.
- E. Provide backflow preventers on all fire protection system risers and upstream of fire protection systems containing foam or glycol. Refer to the Mechanical Chapter, Subsection D10-30GEN, Cross Connection Control, for additional requirements.
- F. Where concealed spaces are formed by non-combustible construction but contain combustible materials (cable trays, combustible insulation, piping carrying flammable/combustible liquids, etc.), fire protection shall be provided in the space using the same requirements in NFPA for combustible concealed spaces.
- G. Provide sprinkler system with a minimum number of control valves. Provide outside stem and yoke (OS&Y) valves with a tamper switch.
- H. Sprinkler systems shall be monitored by a fire alarm panel in accordance with NFPA 72 and shall report locally and to the LANL Central Alarm Station.
- I. The design of suppression systems for the protection of high efficiency particulate air filters shall include testing features that do not require wetting of the filter media.
- J. The LANL FP Group will provide water flow test data upon request.
- K. Prepare fire suppression system drawings in accordance with the LANL Drafting Manual and applicable NFPA installation standards.
- L. Provide a minimum of 500 gpm for hose stream allowance for water-based fire suppression systems, unless otherwise required by the Fire Hazard Analysis and/or with concurrence by the LANL Fire Marshal.
- M. Provide an initiating alarm device (sprinkler system flow or pressure switch) for each area of the building protected by sprinklers, to assist the Fire Department in determining the location of a fire during an emergency.
- N. Refer to the following LANL Standards for additional requirements:
 - 1. [Construction Specification](#) 13930, Wet Pipe Fire Suppression Sprinklers.
 - 2. [Construction Specification](#) 13935, Dry Pipe Fire Suppression Sprinklers.
 - 3. [Construction Specification](#) 13940, Pre-Action Fire Suppression Sprinklers.
 - 4. [Fire Protection Drawings](#) ST-D4010-1, Sprinkler System Riser Details.

D4020 STANDPIPES

This section provides requirements/guides for standpipe system piping downstream of the base of the system riser.

- A. Provide standpipe systems when required by the NFPA Codes or the International Building Code. Also provide in structures with extensive or complex interior layouts, or in structures where exterior doors cannot be held in the open position due to security or ventilation/radiation safety requirements.¹⁶
- B. Comply with requirements of NFPA 14 (Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems). Consultation with the LANL FP Group and the Los Alamos County Fire Department on the type and performance of a new standpipe system is required, with final approval by the LANL Fire Marshal.
- C. Design standpipe systems in accordance with NFPA 14.

D4030 FIRE PROTECTION SPECIALTIES**1.0 PORTABLE FIRE EXTINGUISHERS**

- A. Fire extinguisher types, locations, and signage shall be in accordance with NFPA 10, Standard for Portable Fire Extinguishers. Information on proposed fire extinguishers shall be reviewed by the project point of contact in the LANL FP Group prior to purchasing and installation.
- B. *Guidance: Fire extinguishers are typically furnished by the using group and installed by LANL's Support Services Subcontractor. Alternately, fire extinguishers may be furnished by the Project for new facilities.*
- C. Beyond those already in service, portable extinguishers utilizing Halon 1211 or 1301 as an extinguishing agent shall not be used at LANL.
- D. Refer to LANL Construction Specification 10523, Fire Extinguishers and Cabinets, for additional requirements.

D4090 OTHER FIRE PROTECTION SYSTEMS**1.0 SPECIAL EXTINGUISHING SYSTEMS**

- A. Provide special extinguishing systems to protect hazards that cannot be adequately protected by automatic sprinklers. Select the most appropriate combination of detection, extinguishing agent, and extinguishing system design for the hazard.
- B. Follow as applicable NFPA 11, 11A, 12, 15, 16, 17, 17A, 69, 750, 2001 and other applicable NFPA codes, standards, and recommended practices. Do not install new Halon 1301 systems, but maintain any existing systems in accordance with NFPA 12A.

C. Refer to the following LANL Standards for additional requirements:

1. Construction Specification 13950, Deluge Fire Suppression Sprinklers.
2. Construction Specification 13955, Wet Pipe Foam Water Suppression Sprinklers.
3. This chapter's Section D4010, Sprinklers, as applicable.

ENDNOTES

Note: EMref refers to a LEM system for managing hard-to-find reference copies.

- 1 LANL LIR 220-03-01.1, "LANL Engineering Manual," is the implementation requirement document for this manual. Refer to Sections 2.0 and 3.0 for statements of the purpose, scope and applicability of the LEM.
- 2 Replacement value determined using recognized cost estimating procedures and a national material and labor cost database.
- 3 This exceeds requirements in the IBC but is necessary to assure that significant renovations to a facility are more than just skin deep. Over time this requirement will bring about upgrades to the underlying fire systems in facilities. This percentage was accepted by the TRB per Minutes from the Engineering Manual Technical Review Board meeting on 7/19/00. Fifty percent is also used in Chapter 7; in the 2001 Santa Fe County Urban Wildland Interface Code for use of fire resistant materials in renovations; and for the total luminaire replacement requirement in ASHRAE/IESNA 90.1-2001, Section 4.1.2.2.5.
- 4 [LIR 220-03-01.1](#), LANL Engineering Manual, empowers the POCs as the Authority Having Jurisdiction for their discipline chapter and related national codes and standards, with rare exceptions.
- 5 Part of Appendix G of the University of California/DOE Contract.
- 6 [LIR 220-03-01.1](#), LANL Engineering Manual.
- 7 [LIR 402-910-01](#), LANL Fire Protection Program.
- 8 DOE O 420.1A, "Facility Safety," paragraph 4.2.2.2, requires "Noncombustible or fire-resistive construction, where appropriate." Either Type II requirement is considered a reasonable implementation, since neither has a fire resistive rating requirement for the (1) exterior bearing walls; (2) columns, beams, girders, trusses and arches, supporting bearing walls, columns, or loads from more than one floor; or 3) floor construction (i.e., 0 hours allowed).
- 9 DOE G-420.1/B-O, G-440.1/E-O, Implementation Guide for use with DOE Orders 420.1 and 440.1 Fire Safety Program.
- 10 NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- 11 Memo from Lab Counsel to Tobin Oruch, 7/19/01 (EMref-3).
- 12 Memorandum from T. Oruch to M. Koop dated 3/14/02 (EMref-4) and [LEM Interpretation](#) No. 2002-02, Rev. 0.
- 13 IBC both define Occupancy classes for essentially all types of facilities and activities, and the categories defined by the IBC are not always the same as those defined by NFPA 101. The LANL FP Program assigns precedence to the occupancy definitions and associated life safety requirements found in NFPA 101 per LIR 402-910-01.
- 14 [LIR 403-00-01](#), Los Alamos National Laboratory Emergency Management, and [LA-12900](#) referenced in LIR.

15 LIR 402-910-01, LANL Fire Protection Program.

16 DOE O 420.1A, paragraph 4.2.2.7, requires appropriate equipment to facilitate effective intervention.